

# Ronald Reagan Washington National Airport (DCA) Area Navigation (RNAV) North-Flow Departure Development History and Analysis

## Introduction

This document was prepared in response to questions regarding development of LAZIR procedures at DCA, including how and when these procedures have periodically been utilized.

## Background

This is an historical overview of RNAV north-flow departure procedure development at DCA and an analysis of the operations flown.

The NATIONAL is a conventional navigation departure procedure that has been used at DCA for more than 20 years. When DCA is in a north-flow operation using runways 01 and 33, pilots on northwest departures are instructed to comply with a noise abatement procedure. The instruction reads, "Follow the Potomac River until abeam the Georgetown reservoir or the DCA VOR D4.0 [DME], then join the DCA VOR R-328."

On March 10, 2011, the LAZIR RNAV departure serving runways 01 and 33 was published. The LAZIR defined a route of flight that generally guides aircraft along the Potomac River to reduce noise exposure to surrounding communities. The initial waypoints include ADAXE, BEBLE, and COVTO. For reference, COVTO is approximately seven nautical miles (NM) northwest of the airport.

Soon after implementation, the Federal Aviation Administration observed several navigation system irregularities that were unacceptable to Air Traffic Control (ATC). This included the possibility of a pilot violating Prohibited Area-56 (P-56) airspace, which encompasses airspace around the U.S. Capitol and White House, when LAZIR was flown. As a result, LAZIR was seldom used in the first four years after its publication until technical and procedural solutions were found.

Minor changes were made to LAZIR (e.g., LAZIR 2, LAZIR 3, LAZIR 4, LAZIR 5) over the next few years in an attempt to address navigation system compatibility issues and to revise chart notes. In March 2015, the FAA began flight validation activities using the published LAZIR 5. During flight validation, data was collected for revising the north flow RNAV departure procedures by (1) increasing flight time over the Potomac River to mitigate noise and (2) increasing the distance between aircraft and Prohibited Area 56 (P-56). The list of participating operators was captured in a Letter of Understanding (LoU) kept on file with DCA Tower. The LoU has been updated periodically as airlines were granted approval, or voluntarily declined, to use the LAZIR procedure. Pilots of aircraft participating in the flight validation accepted the LAZIR RNAV departure clearances in lieu of the normally issued NATIONAL conventional departure. Non-participating aircraft continued to fly NATIONAL.

On April 30, 2015, three new DCA RNAV departures were published for multiple runways, including 01 and 33. Nearly two months later, on June 25, six more RNAV departures, serving all runways, were published for DCA. This publication brought the total number of northbound RNAV departures serving runways 01 and 33 at DCA to 10. Each of these RNAV departures share the same initial routing for the respective runway transitions until waypoint COVTO. This initial routing through COVTO is identical to the LAZIR 5 routing. Each procedure then diverges to different terminal airspace exit points.

The final version of LAZIR 5 was removed from the procedure inventory on October 15, 2015. The other nine RNAV departures remained and retain common initial routing from runways 01 and 33. These nine procedures have the following names: "CLTCH," JDUBB," "HORTO," "REBL," "SCRAM," "WYNGS," "BOOCK," "DOCTR," and "SOOKI."

The vast majority of all turbojet departure operations in a north-flow configuration at DCA are assigned either the sole conventional departure (NATIONAL) or an RNAV departure. Between March 2011 and April 2015, the only available RNAV departure was LAZIR. From May 2015 through June 2015, aircraft proceeding eastbound received the RNAV Standard Instrument Departure (SID) associated with their destination, while westbound aircraft received the LAZIR. From July 2015 onward, aircraft were assigned a published RNAV departure corresponding to the filed route of flight.

## Methodology

The data used for this analysis includes radar tracks spanning five years between March 1, 2011 and January 1, 2016. Due to missing or corrupt data, 78 days of the 1,767 days of data was not used.

A computational algorithm was used to assess conformance of flight tracks to RNAV departure procedures off runways 01 and 33. Flight tracks that conformed closely to the initial charted route common to all ten RNAV departures were categorized as RNAV operations. Per DCA operational practices described above, all non-conforming aircraft were considered conventional operations flying the NATIONAL departure. This track level analysis was required since the SID information is not consistently available in the filed flight plan.

This algorithm measures cross-track distance along each leg in the procedure and cross-track thresholds were computed. Thresholds were then validated using a visual inspection of 25 weeks of RNAV tracks, which is detailed in the validation section below. Once a threshold was chosen, each track point was considered "on" the leg if its cross track distance fell under this threshold.

The total amount of time below the cross track threshold compared to the total time on each leg was used as a second parameter to determine conformance to that leg. This parameter was also selected with the aid of the same 25 weeks of visually identified RNAV departures. A flight was only considered to be on a RNAV procedure if the conformance thresholds were met for all three legs in question. The parameters are shown in

Table 1.

Table 1: Algorithm Parameters

Leg Type	Leg Name	Cross Track Threshold (NM)	Ratio of Time Conforming
CF	To ADAXE	0.234	0.436
TF	ADAXE-BEBLE	0.205	0.782
TF	BEBLE-COVTO	0.362	0.085

## Validation

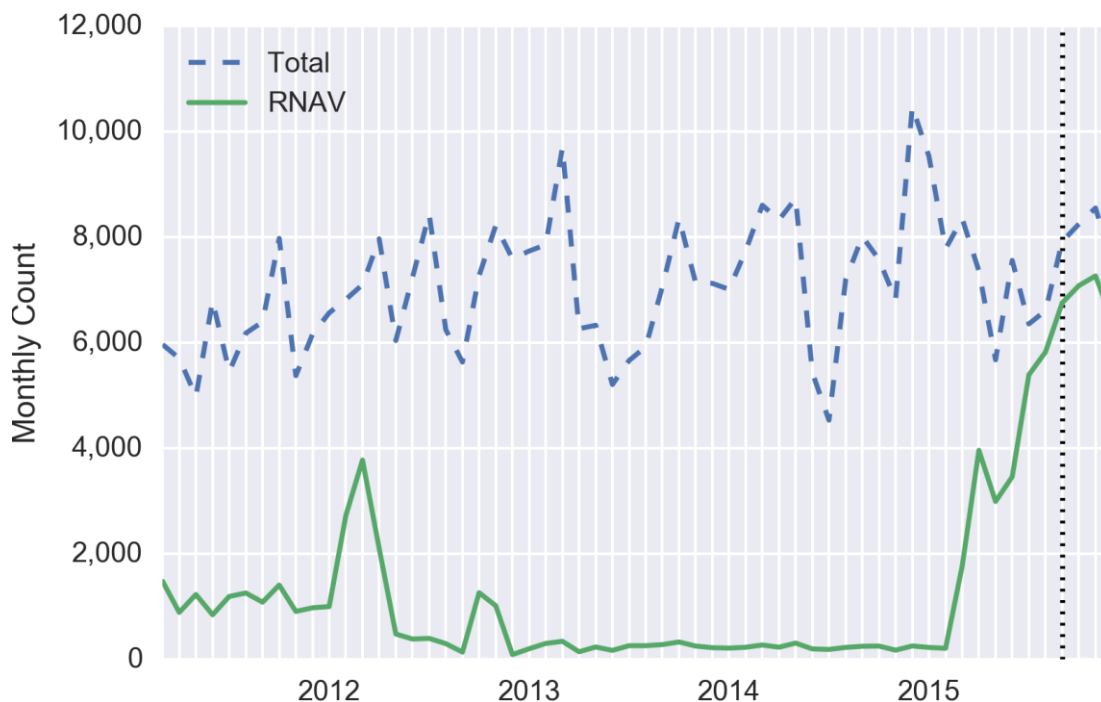
The counts of flights identified by the algorithm were compared against the visually identified RNAV departures. The counts over the 25 week period from March 16, 2015 to September 5, 2015 were found to be within one percent difference. The average difference over each week was less than six percent for the entire date range.

Random samples outside of this validation period were also visually examined and were found to correctly identify flights on the RNAV procedure.

## Results

A count of the number of departures from runway 01 or 33 by month is shown in the following figure. The total number of operations, as well as the RNAV operations, are included.

Figure 1: Monthly Departure Counts (RWY 01/33)



The last four months of 2015 (indicated by a dotted vertical line in Figure 1) demonstrate high RNAV usage that is expected to continue. In this period, 27,518 out of 32,207 flights (85 percent) departing from runway 01 or 33 flew the RNAV procedure.

A summary of the yearly counts (March 1, 2011 through the end of 2015) is shown in Table 2 below.

Table 2: Yearly Departure Counts

Year	Total RWY		RNAV
	01/33	Conventional	
2011 (Mar. – Dec.)	60,957	49,711	11,246
2012	85,091	71,447	13,644
2013	84,312	81,344	2,968
2014	90,410	87,642	2,768
2015	91,403	40,070	51,333